Multiphasic on/off pheromone signalling in moths as neural correlates of a search strategy

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Résumé en anglais	Insects and robots searching for odour sources in turbulent plumes face the same problem: the random nature of mixing causes fluctuations and intermittency in perception. Pheromone-tracking male moths appear to deal with discontinuous flows of information by surging upwind, upon sensing a pheromone patch, and casting crosswind, upon losing the plume. Using a combination of neurophysiological recordings, computational modelling and experiments with a cyborg, we propose a neuronal mechanism that promotes a behavioural switch between surge and casting. We show how multiphasic On/Off pheromone-sensitive neurons may guide action selection based on signalling presence or loss of the pheromone. A Hodgkin-Huxley-type neuron model with a small-conductance calcium-activated potassium (SK) channel reproduces physiological On/Off responses. Using this model as a command neuron and the antennae of tethered moths as pheromone sensors, we demonstrate the efficiency of multiphasic patterning in driving a robotic searcher toward the source. Taken together, our results suggest that multiphasic On/Off responses may mediate olfactory navigation and that SK channels may account for these responses.
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